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Transport of gases: miscellaneous

Hydraulic pressure testing of pressure receptacles

Transmitted by the International Organisation for Standardisation (ISO), the European Cylinder Makers Association (ECMA) and the European Industrial Gases Association (EIGA)[1]

Introduction

1. The text of 6.2.1.5.1 (g) concerns the hydraulic pressure test during the initial inspection and test of pressure receptacles. It reads:

> "A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without expansion greater than that allowed in the design specification."

The phrase "design specification" does not have a defined meaning and is not used elsewhere in the Model Regulations so its meaning is open to question. Also, the words "expansion greater than that allowed …" can be understood to mean that a measurement of expansion is necessary. Since a working group containing several people also involved in developing the ISO standards for gas cylinders proposed this text, it can be confidently stated that this was not the working group's intention. ISO standards allow a choice of the type of hydraulic pressure test since they are both valid. This paper proposes to remove these weaknesses by replacing the above second sentence with more accurate text.

[1] In accordance with the programme of work of the Sub-Committee for 2013-2014 approved by the Committee at its sixth session (refer to ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

2. Until 2013, the requirement for the hydraulic pressure test of non-UN pressure receptacles in ADR was:

> "A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without undergoing permanent deformation or exhibiting cracks."

In the 2013 edition, in the interests of global harmonization this text was dropped and the requirement became harmonized with the UN Model Regulations text shown in paragraph 1. It can be inferred from the previous ADR text that the universal practice in Europe was to carry out the proof pressure test which consists of holding the pressure receptacle at test pressure while inspecting visually to detect deformation, cracking and leaks. On the other hand, the usual practice in North America and elsewhere, to use the volumetric expansion test in which the pressure receptacle is immersed in water and measurement of the water displaced during the pressure test allows the permanent expansion to be measured. There are some designs of gas cylinders for which this style of test is beneficial, but the ISO standards listed in the Model Regulations do not necessarily require the use of this test. The ISO standards allow either test to be used because both are acceptable methods of testing and the choice is given to allow the available equipment to be used.

3. Unfortunately, the adoption of this UN text in Europe has lead to confusion by some inspection bodies as to the intention of the change in the regulation and lead to the false conclusion that the volumetric expansion test is required in all cases. The first weakness in the text is the phrase "design specification". Discussion with those involved in the development of this text confirmed that design specification was meant to convey 'the design and construction technical standard' referred to in 6.2.1.1.3 and 6.2.1.2.2 or in the absence of such a standard the "technical code" referred to in 6.2.3.1. Looking at the use of "specification" in the requirements of Chapter 6.2 it only occurs in 6.2.1.4.1 under "Approval of pressure receptacles. "The technical documentation shall include full specifications on design and construction, and full documentation on the manufacturing and testing". This use of the word "specification" appears to lead to the conclusion that a defined permissible expansion should be part of the type specification, so it is necessary to establish the expansion as part of the type approval process and hence require the volumetric expansion test in the initial inspection and test. Whatever the merits of the above argument, it is certain that removal of doubt as to the meaning of "design specification" is very desirable in the quest for clear regulations. Therefore we propose to replace "design specification" by "design and construction technical standard or technical code".

4. As mentioned in paragraph 1 'expansion greater than that allowed ...' implies to those unfamiliar with the ISO standards that measurement is required. The authors of this paper believe that it is inappropriate to single out expansion as a criterion, especially since it is not specified whether this is elastic or permanent expansion. Leakage is also a key indicator of the fitness of a pressure receptacle and may occur without permanent expansion particularly in a welded pressure receptacle. Acceptance criteria are not specified for the hydraulic pressure test in Chapter 6.7 (see 6.7.3.15.3 or 6.7.4.14.3 for initial testing of portable tanks for gases) and it is, in our opinion, unnecessary to specify criteria in Chapter 6.2. Technical standards and codes always give instructions on how to conduct and assess a hydraulic test and what are the acceptance criteria. This is evident from the existing words that can only mean that acceptance criteria are in the standard or its equivalent. Furthermore, the acceptance criteria are related to the type of design and the test used, so it is better to leave their specification to the standards or codes.

Proposal 1

5. Replace "design specification" by "design and construction technical standard or technical code" so that 6.2.1.5.1 (g) reads;

> A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without expansion greater than that allowed in the design **and construction technical standard or technical code**.

Proposal 2

6. Replace the words "withstand the test pressure without expansion greater than that allowed in" by "meet the acceptance criteria specified" so that 6.2.1.5.1 (g) reads:

> A hydraulic pressure test. Pressure receptacles shall **meet the acceptance criteria specified** in the design specification.

7. Accepting both proposals results in the following text:

> 6.2.1.5.1 (g) A hydraulic pressure test. Pressure receptacles shall meet the acceptance criteria specified in the design and construction technical standard or technical code.